Measurement of the ^{58}Ni(n,t)^{56}Co, ^{59}Co(n,p)^{59}Fe and ^{63}Cu(n,α)$^{60m+g}$Co Reaction Cross Sections from 14 to 20 MeV

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Studies of excitation functions of fast-neutron induced reactions are important for testing nuclear models and in a wide range of applications such as fission and fusion reactor technologies and proposals for accelerator driven systems (ADS) [1,2]. Nevertheless, for many reactions, especially in the energy range above 15 MeV the cross sections data are either sparce or discrepant. The hydrogen and helium production cross sections on Co, Ni and Cu as a structural materials are of particular importance for the estimation of the material damage and handling limits. Activation cross sections are needed to determine the induced long-lived radionuclides whose decay activities impact the scenario of waste management and materials recycling. One of the major radionuclides of importance to the medium-term waste management consideration is ^{60}Co.

New results were obtained for the ^{58}Ni(n,t)^{56}Co, ^{59}Co(n,p)^{59}Fe ^{63}Cu(n,α)$^{60m+g}$Co activation reaction cross sections in the energy range from 13.3 to 21 MeV. The measurements have been performed in response to the request of the EAF Working Group on Evaluation Processing, Validation and Benchmarking. The irradiations were carried out at the 7MV Van de Graaff accelerator at IRMM, Geel. Quasi-mono-energetic neutrons with energies between 13.3 and 20.6 MeV were produced via ^{3}H(d,n)^{4}He reaction at 1, 2, 3, and 4 MeV incident deuteron energy. All reaction cross sections measured in the present work are referenced to ^{27}Al(n,α)^{24}Na standard reaction cross section. Neutron flux spectra were determined using neutron-spectrum information obtained by time-of-flight method and spectral index method that involves various monitor reactions with distinct energy thresholds. Standard γ-ray spectrometry was employed for measurement of radioactivity. Corrections have been applied for sample irradiation and counting geometry, beam intensity variation during irradiation, background neutrons, neutron absorption and scattering, γ-ray absorption and γ-ray sum coincidences. For more details about the method see Ref. 3.

The measurment results are compared with work by other authors, current evaluated data files and new model calculations.

1) P. Batistoni et al., EFF-DOC 828.
2) Y. Ikeda, J. of Nucl. Sci. and Technol., Supplement 2, (August 2002), 13-18.
3) A. Fessler et al., Nucl. Sci. Eng. 134, 171 (2000)

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